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1915 | 2015



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Ecogeomorphological assessment of agricultural abandonment in semiarid Mediterranean areas: a basis for natural reconstruction

**F. Robledano¹, A. Romero-Díaz²,
F. Belmonte², V.M. Zapata¹, C.
Martínez-Hernández² & V.
Martínez-López¹**



⁽¹⁾ Dept. Ecology & Hidrology

⁽²⁾ Dept. Geography

Background

In **semiarid Mediterranean** areas of **Spain**

- **agricultural policies (CAP)**
- **socioeconomic drivers**
- reinforced by **climate change**

Promote the **abandonment** of large
agricultural surfaces critical for **soil**,
water and **biodiversity** conservation.

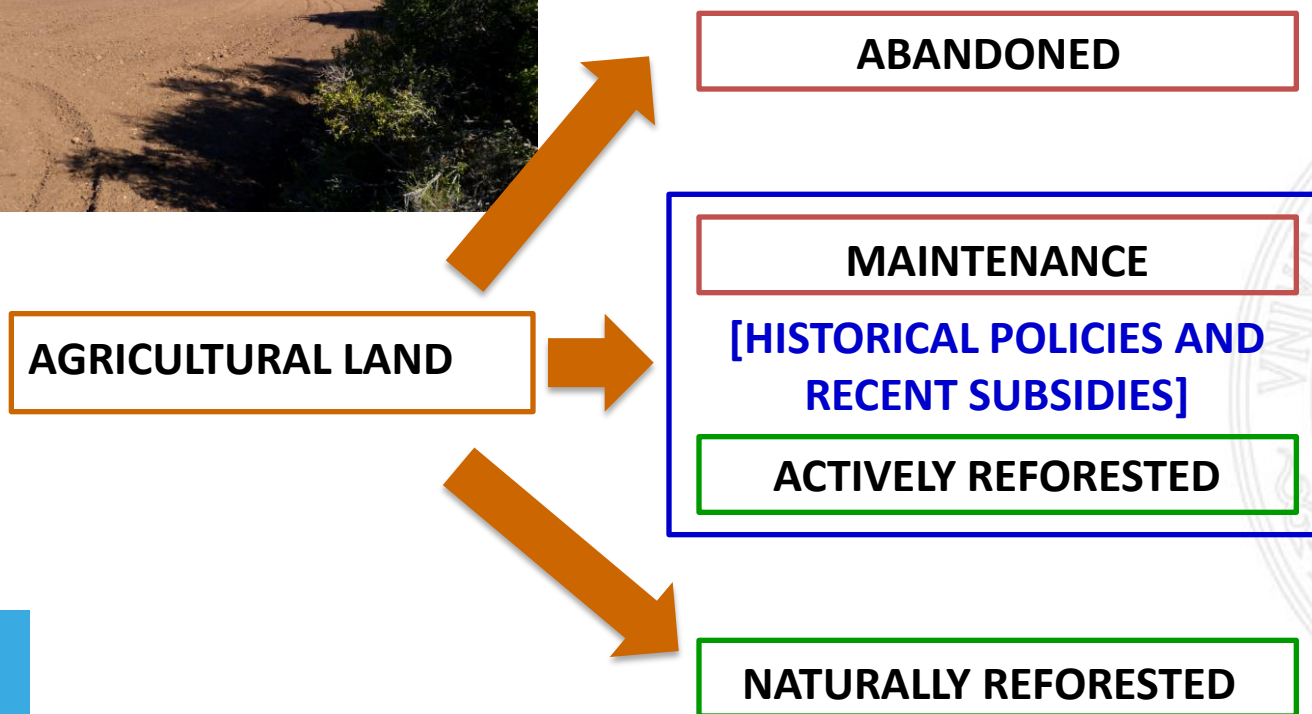


Background

Natural reconstruction (self-regeneration, passive restoration) can be

- a **cost-effective management option**
- an **alternative to reforestation policies**







AGRICULTURAL LAND

ABANDONED

MAINTENANCE

**[HISTORICAL POLICIES AND
RECENT SUBSIDIES]**

ACTIVELY REFORESTED

**Huge investment:
SPAIN
777.6M€
(2007-2013)
296.374 ha**



**FAILURES IN
SEMIARID AREAS**





AGRICULTURAL LAND

ABANDONED

MAINTENANCE

**[HISTORICAL POLICIES AND
RECENT SUBSIDIES]**

ACTIVELY REFORESTED

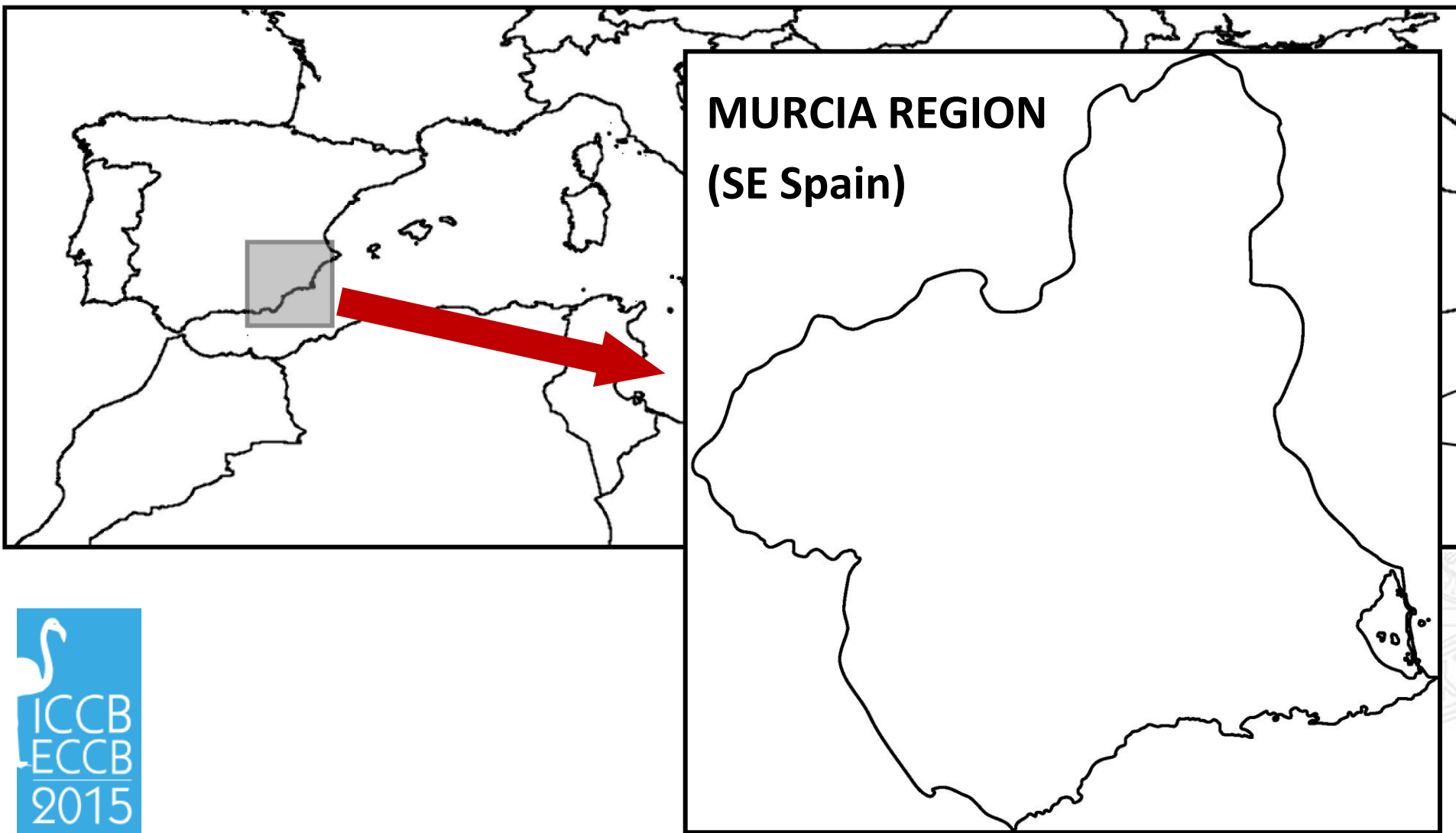


**Current financial
instruments**

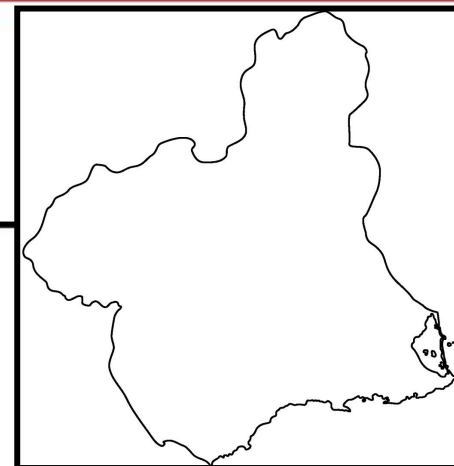
- **AVOID SAME FAILURES**
- **OPTIMIZE RESOURCES**



Background



1991-2001: **Cultivated land:** - 46%
 Non-cultivated areas: + 33%
 (mainly forests and abandoned agricultural land)



MODERN AGRICULTURE

<1981

1981

1982 - 2006

2007 - 2011

Cultivation

In some year during this period, abandonment of
previously cultivated plots starts

Structural abandonment
(remains uncultivated)

Assessment framework

- **Potential for ecosystem self-recovery** in semiarid agricultural areas of the Mediterranean
- Feasibility of applying **passive restoration methods**

Integrated assessment of **physical conservation** and **biodiversity** indicators, with:

- **substrate lithology** as key factor controlling physical vulnerability, and
- **colonization dynamics**-and its mechanisms (sources, agents and filters) as main driver of recovery

Ecogeomorphological responses to land abandonment in Southeastern Spain [SENECA Research Foundation's Project 15233/PI/10]

SCALES AND APPROACHES:

METHODS

NATURE & BIODIVERSITY ISSUES

Regional assessment

Thematic mapping

NATURA 2000 coverage

**Lithological gradient x
chronosequence**

**Ecogeomorphological
assessment (pilot areas)**

**Plant and bird conservation and
functional value**

**Stratified (bioclimatic x
lithological) regional
survey**

**Pilot areas + extensive
survey x bioclimatic
layers**

**Plant, bird and invertebrate
(Gastropoda) conservation and
functional value**

Regional modelling

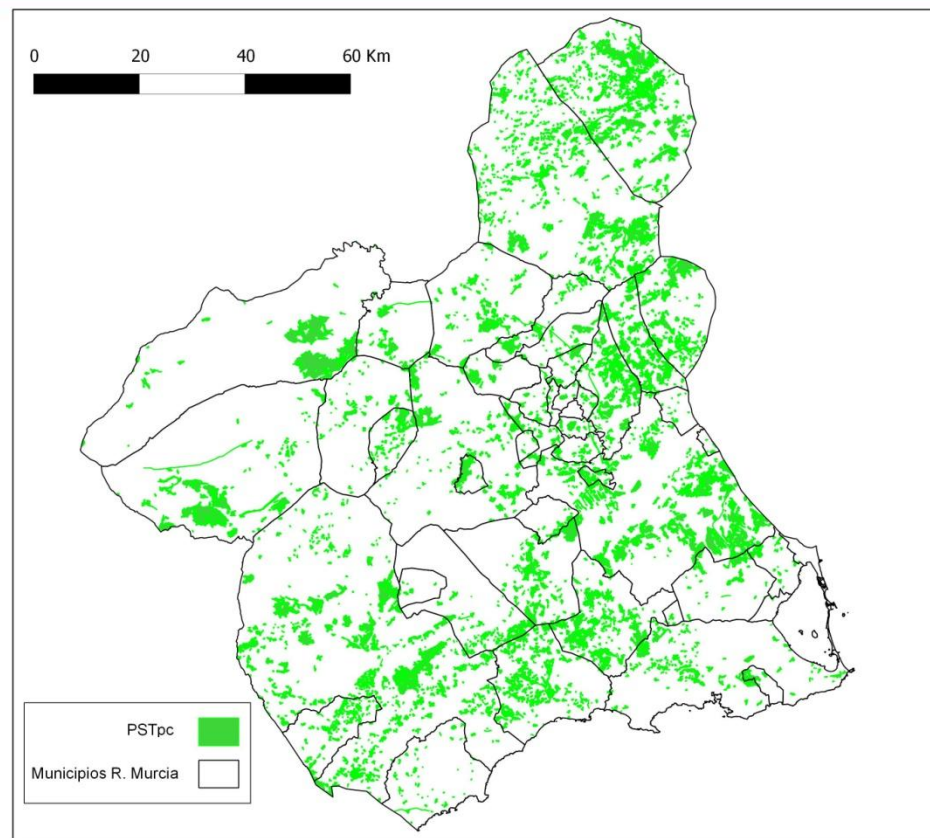
**Ecological Niche Factor
Analyses (ENFA)**

**Contribution to selected *rural*
species habitat preferences**

Main results

1 REGIONAL ASSESSMENT

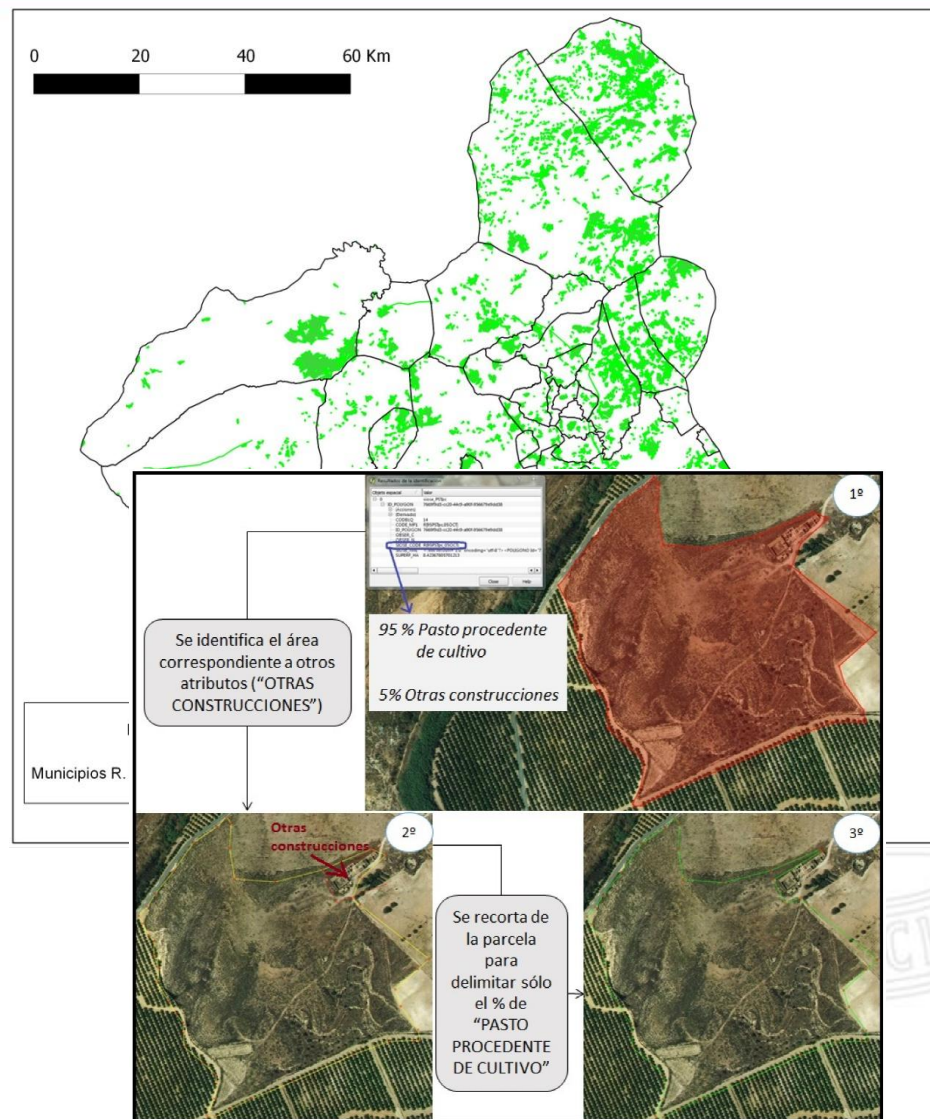
Land use maps : previously
cultivated) = pasture and
scrub *from* ploughed
land



1 REGIONAL ASSESSMENT

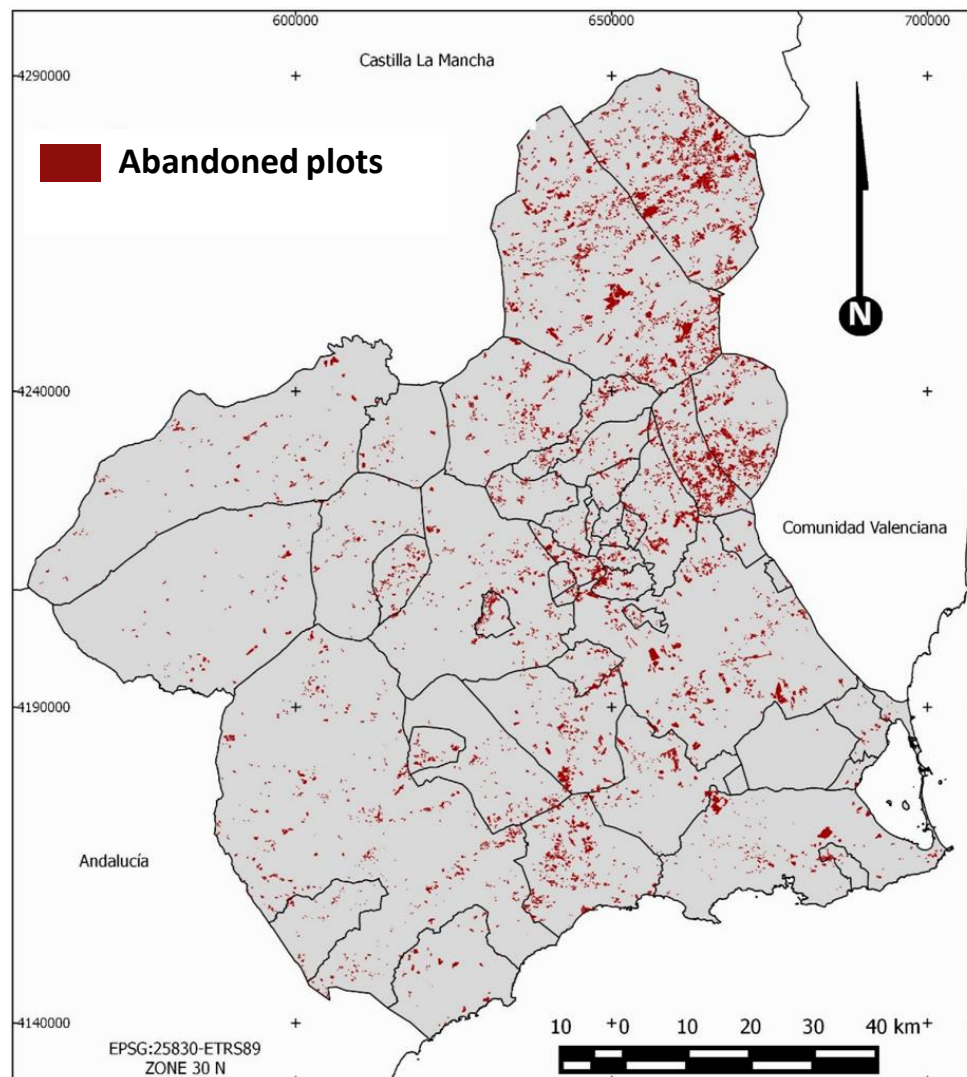
Land use maps : previously cultivated) = pasture and scrub *from* ploughed land

Photointerpretation



Main results

1 REGIONAL ASSESSMENT



Main results

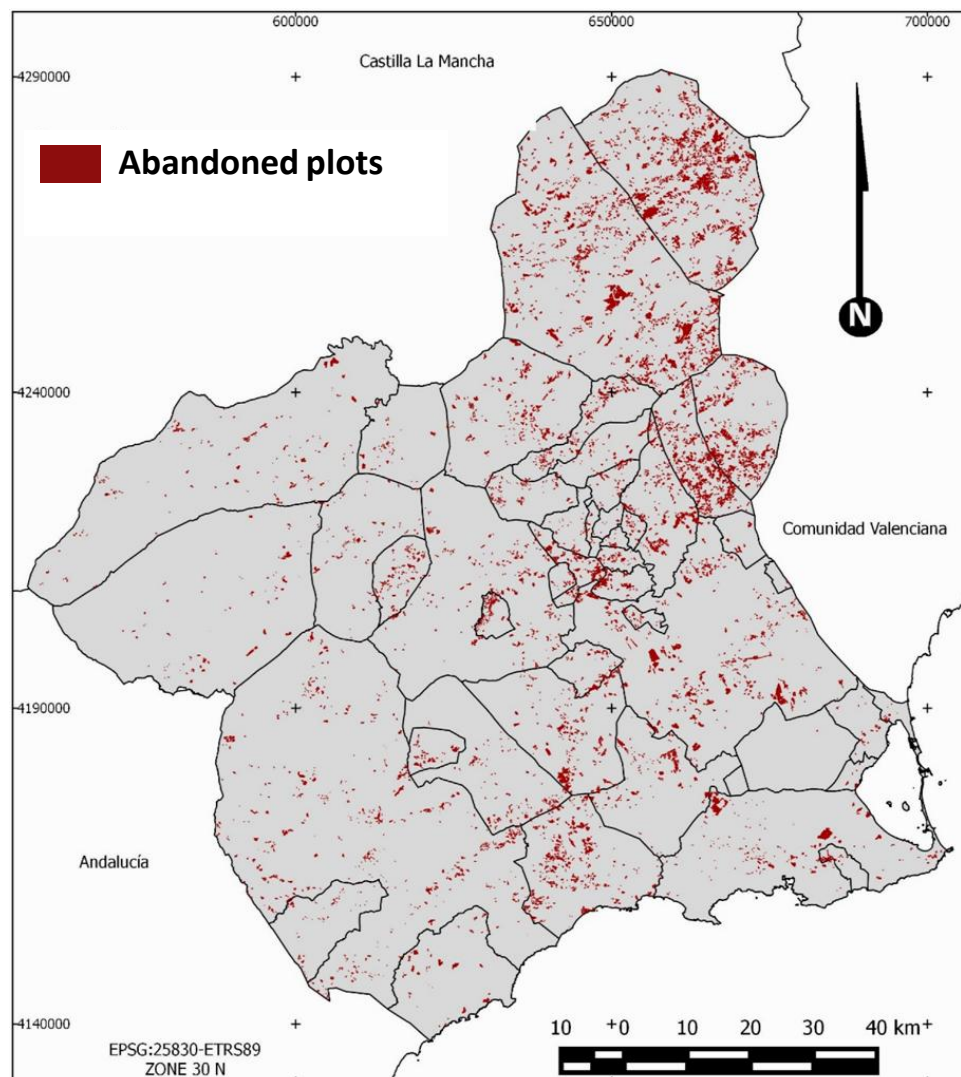
1 REGIONAL ASSESSMENT

Extent:

24.522 ha

2,2% of the region's surface

**4% of the region's agricultural land
(mostly dryland cereal and almond)**



1 REGIONAL ASSESSMENT

Extent:

24.522 ha

2,2% of the region's surface

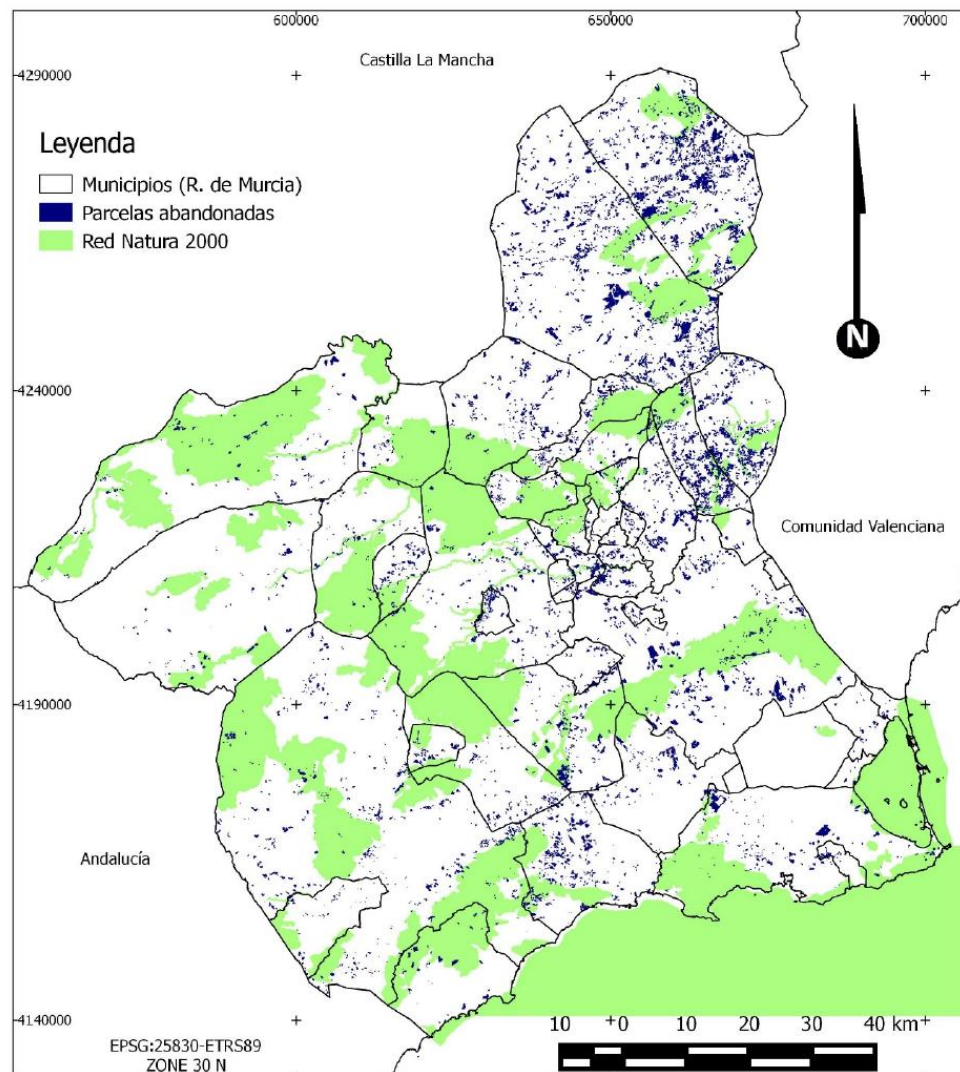
4% of the region's agricultural land
(mostly dryland cereal and almond)

**Relationship with NATURA
2000 network**

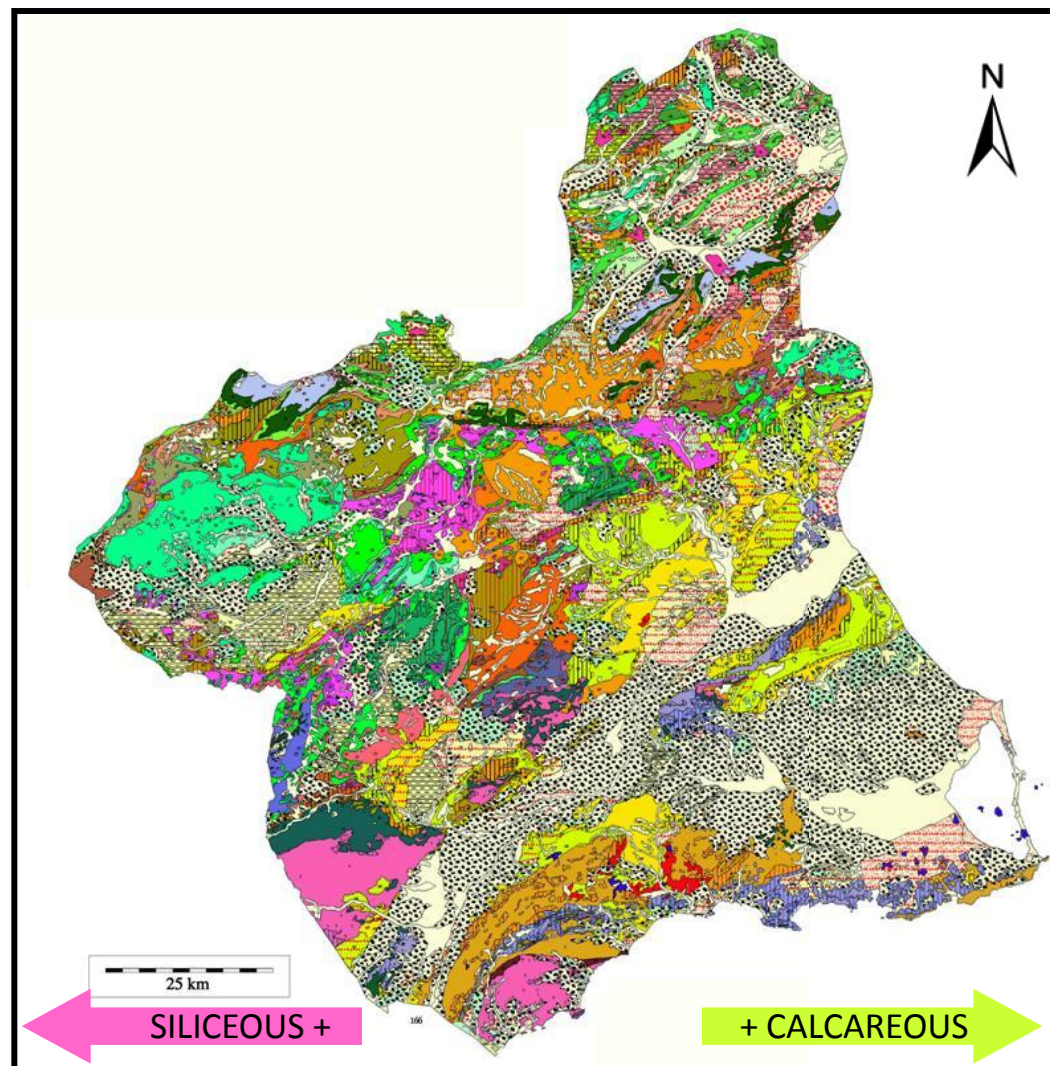
20,8% of total abandoned land

2% of the regional network's area

Main results



2 LITHOLOGICAL GRADIENT X CHRONOSEQUENCE

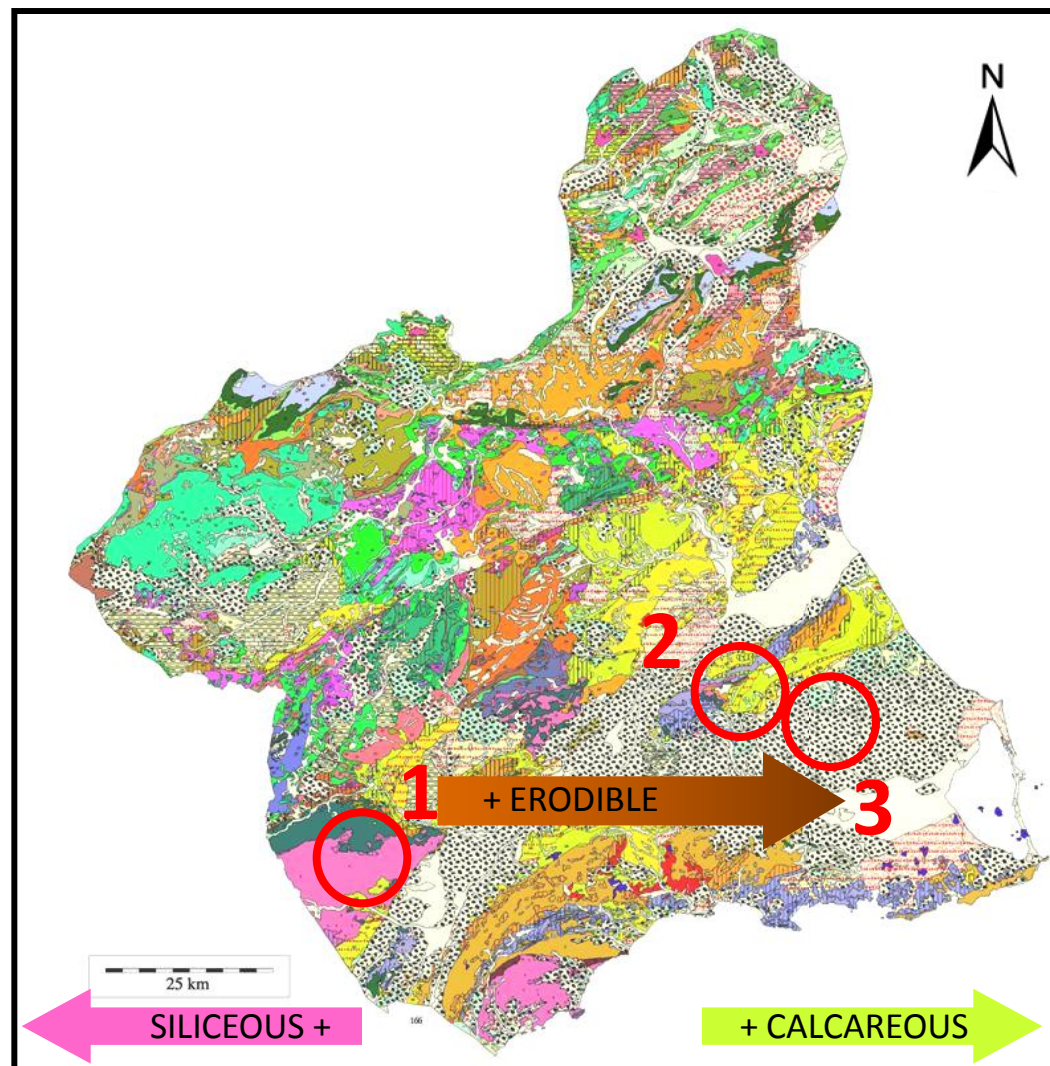


Robledano, F. et al. 2014.
Agriculture, Ecosystems and
Environment, 197: 222-242

Main results

2 LITHOLOGICAL GRADIENT X CHRONOSEQUENCE

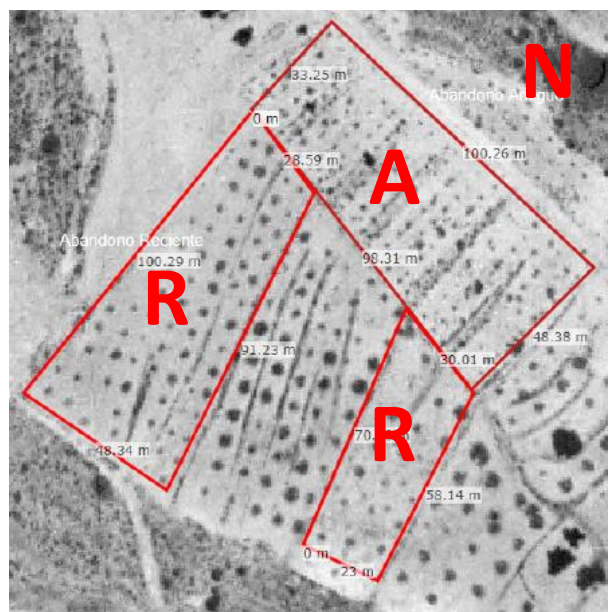
- 1 – Metamorphic
- 2 – Limestone
- 3 – Marls



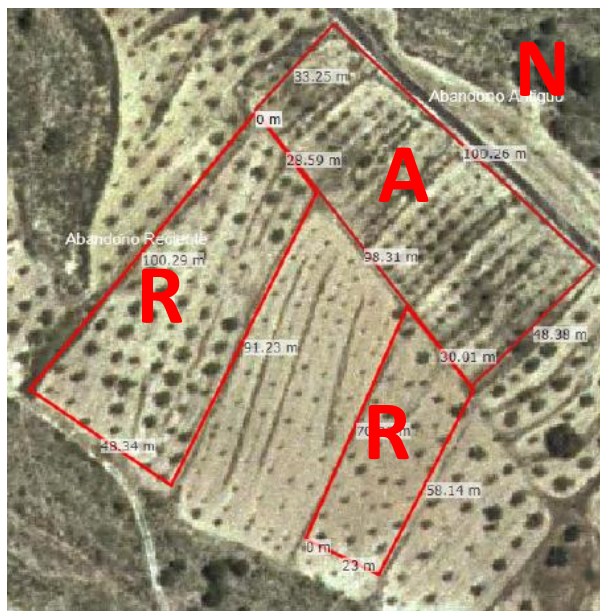
R – Recent abandonment (< 20 years)

A – Ancient abandonment (> 20 years)

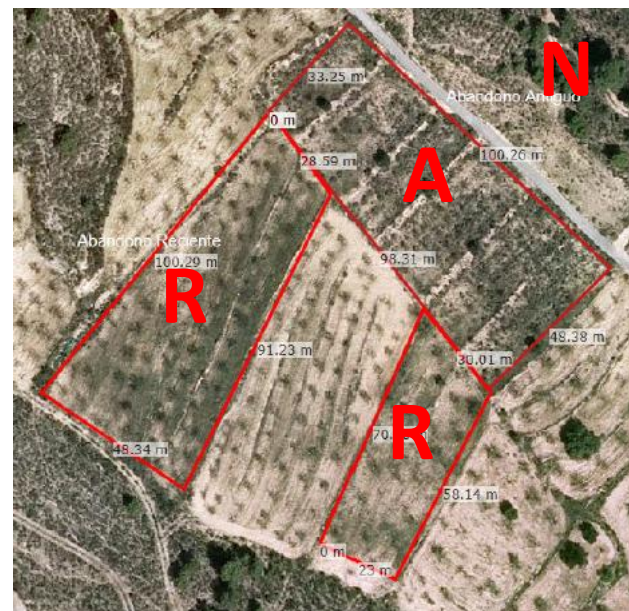
N – Natural areas



1981



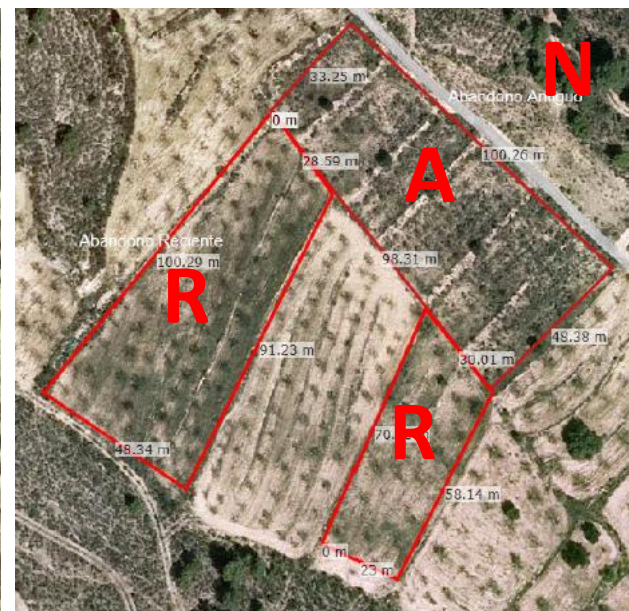
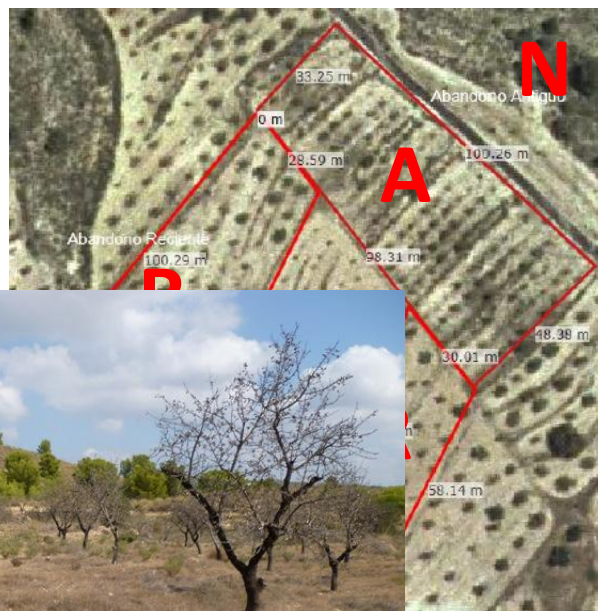
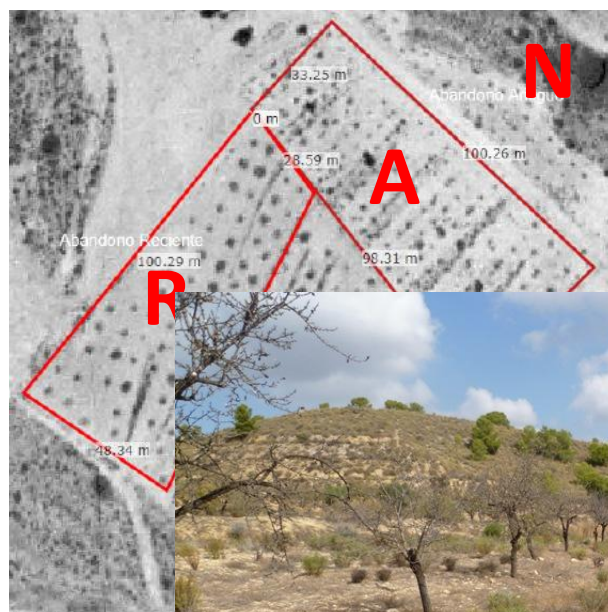
2002



2009

R – Recent abandonment (< 20 years)

A – Ancient abandonment (> 20 years)

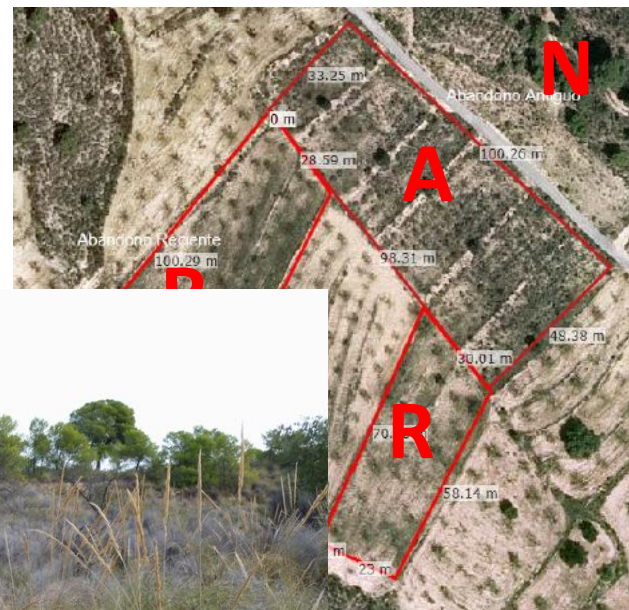
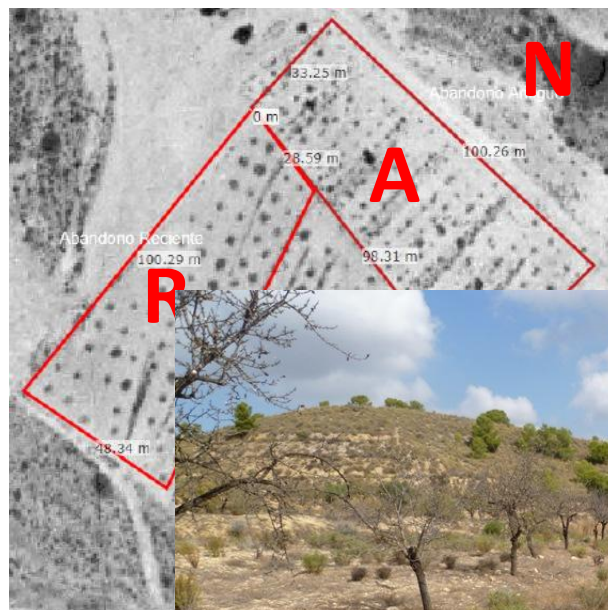


2002

2009

R – Recent abandonment (< 20 years)

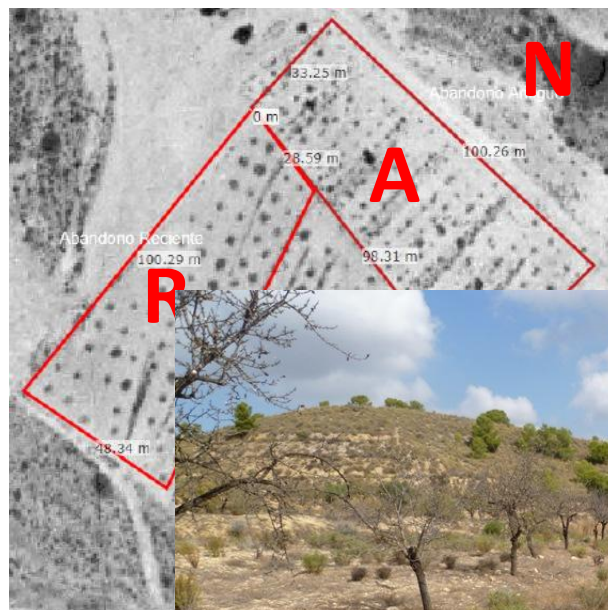
A – Ancient abandonment (> 20 years)



2009

R – Recent abandonment (< 20 years)

A – Ancient abandonment (> 20 years)



BIODIVERSITY INDICATORS

- Biodiversity value indices: plot (field) scale

LITHOLOGY

Marls

Limestone

Metamorphic

PHYSICAL RESTRICTIONS

SOIL DEGRADATION

EROSION RISK

BIODIVERSITY RESPONSE

Woody plants:

- Composition (sps richness)
- Structure (physiognomy-life forms)
- Function (interactions)
- Conservation value (Red Data Books)

Birds:

- Composition (sps richness)
- Structure (communities)
- Function (dispersal)
- Conservation value (Red Data Book, SPEC, EU Birds Directive)



BIODIVERSITY INDICATORS

- Biodiversity value indices: plot (field)

LITHOLOGY

Marls

PHYSICAL RESTRICTIONS

Soil organic matter and
nutrients decrease after
abandonment
Low infiltration capacity

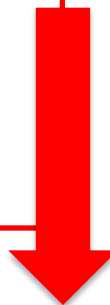
High erosion rates
Strong sheet erosion
Rill & gully erosion
Piping phenomena

BIODIVERSITY RESPONSE

High plant conservation value for
endangered species

Steppic physiognomy

High bird conservation value

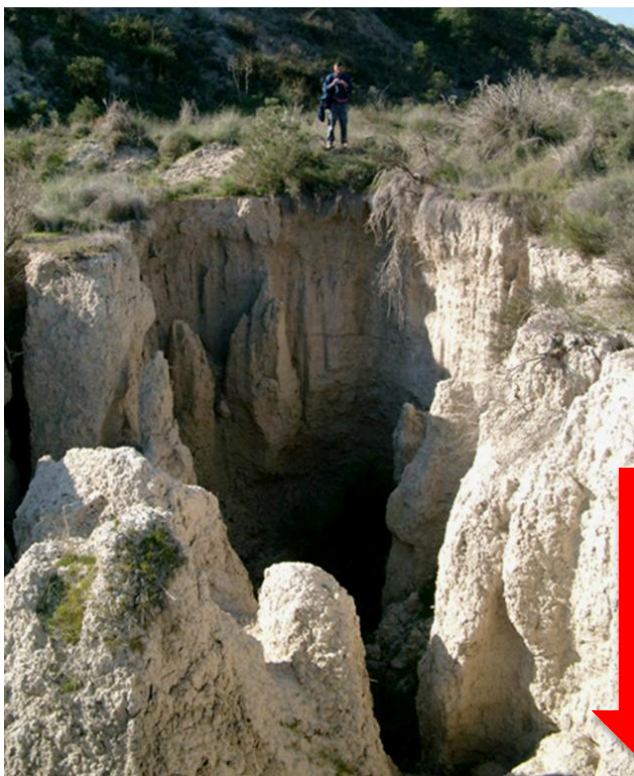


Main results

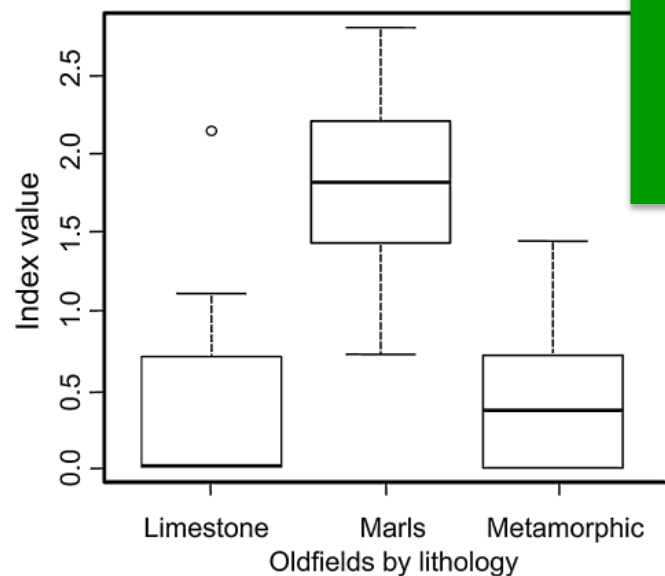
BIODIVERSITY INDICATORS

- Biodiversity value indices: plot (field) scale

Marls



SPEC



C. González-Revelles



Main results



Arrested
succession

?

LITHOLOGY

Limestone

Metamorphic

~~PHYSICAL RESTRICTIONS~~

Scrub
encroachment

?

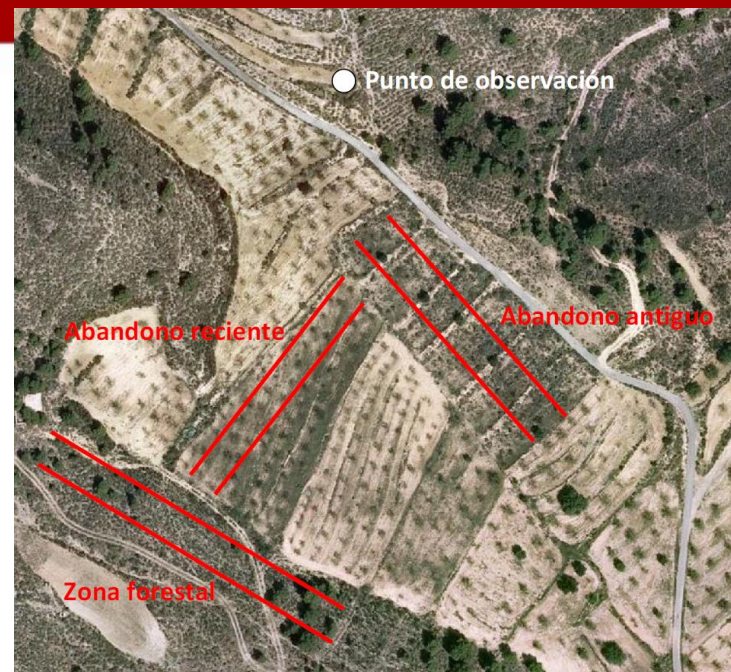
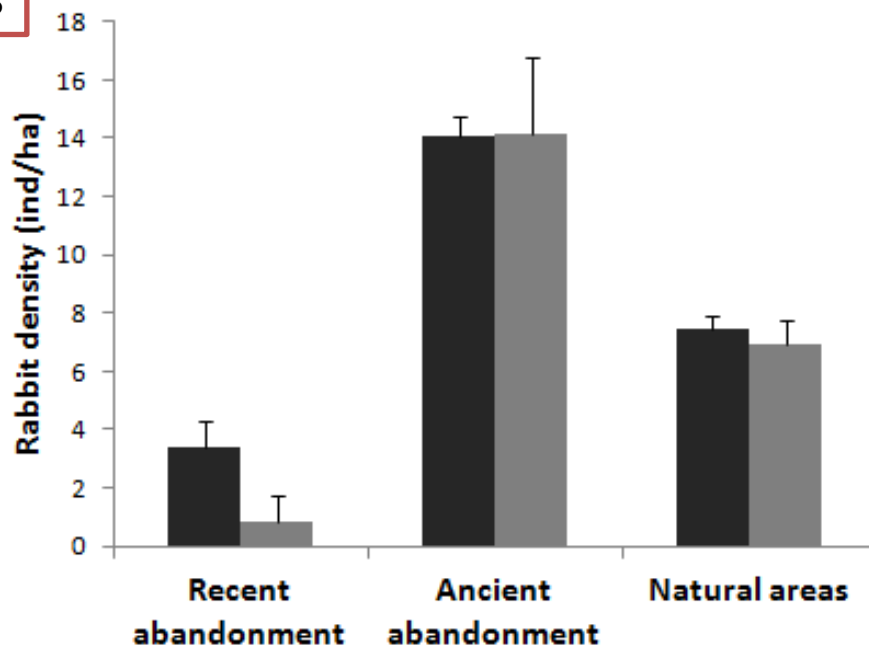


Main results

BIODIVERSITY INDICATORS

- Biodiversity value indices
- Key species: Rabbit

Limestones



■ Observation
■ Transect

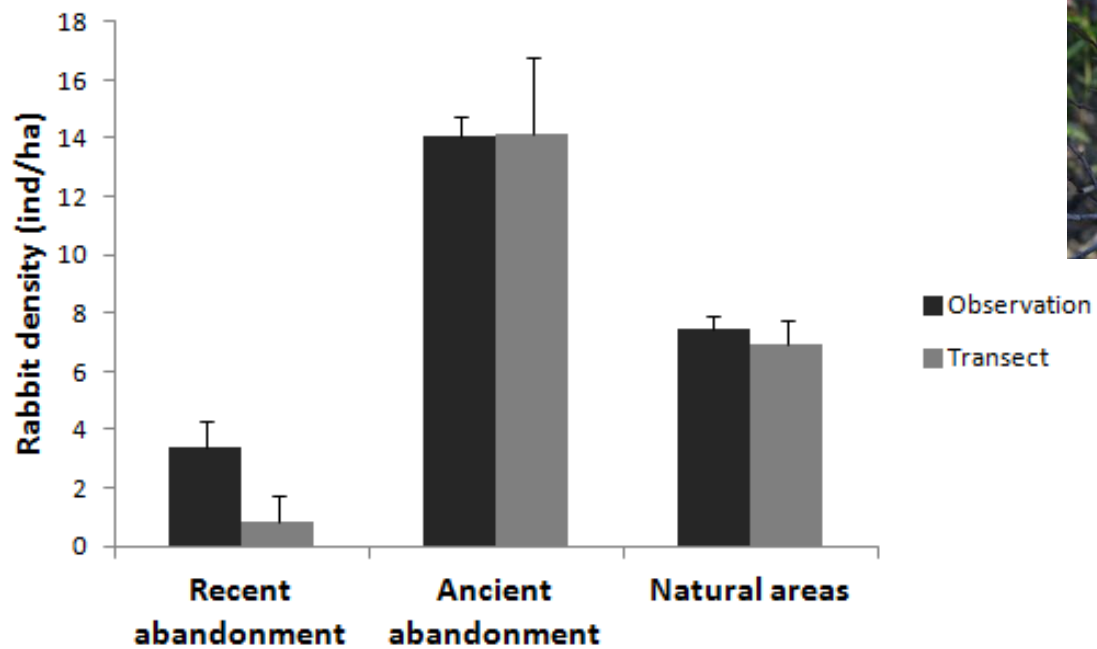


Main results

Heredia, J. 2015. MSc Thesis. Univ. Murcia



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3 STRATIFIED (BIOCLIMATIC) x LITHOLOGICAL SURVEY

1 – Metamorphic

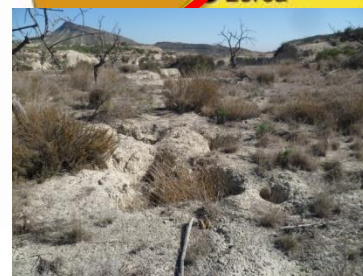
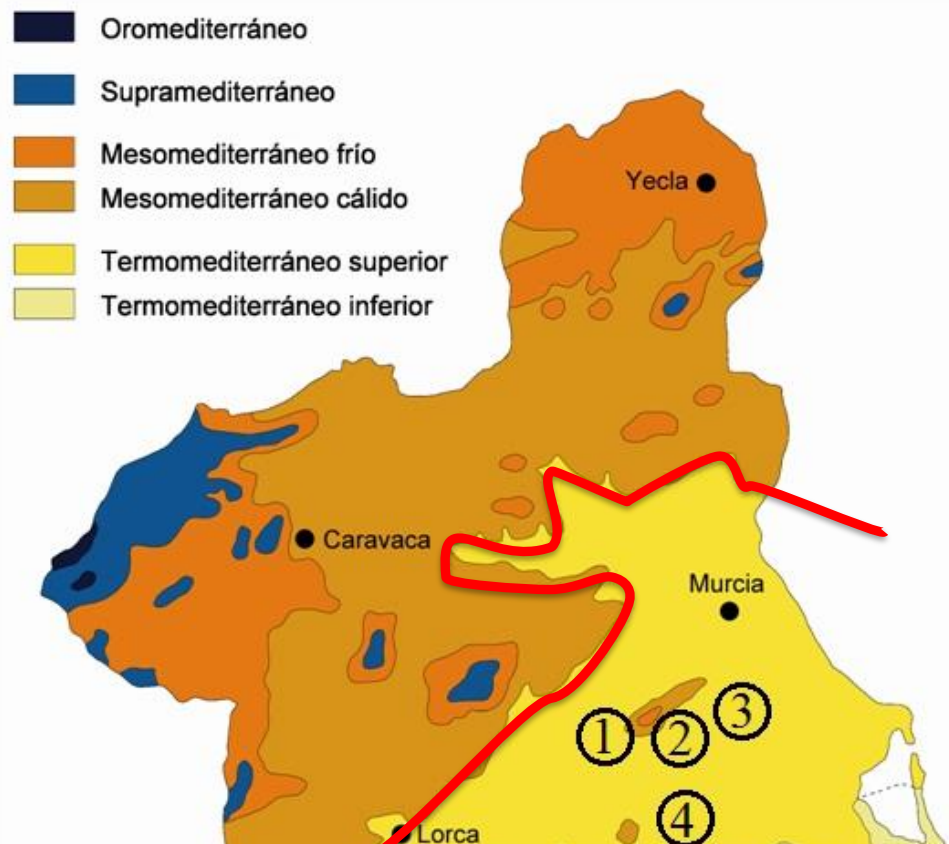
2 – Limestone

3 – Marls

x

- THERMOMEDITERRANEAN

- MESOMEDITERRANEAN



Main results

4 BIODIVERSITY RESPONSE (ECOGEOGRAPHICAL MODELING):

ENFA

Preferences

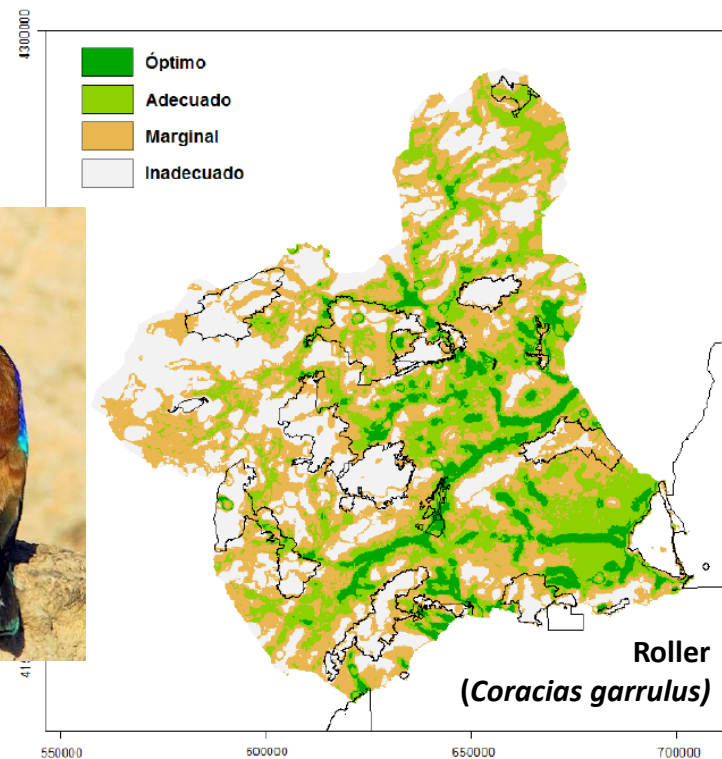
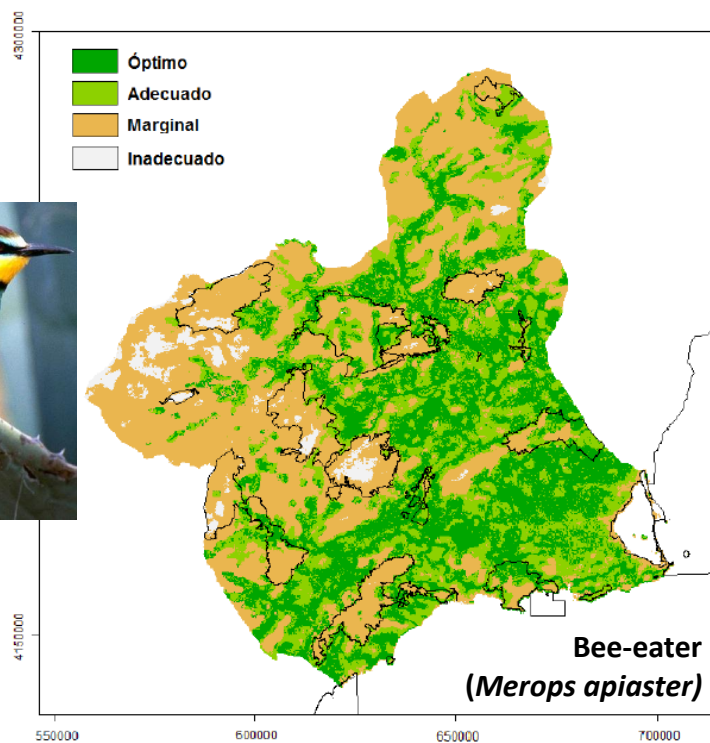


ABANDONED LAND



	Bee-eater (<i>Merops apiaster</i>)	Roller (<i>Coracias garrulus</i>)
	Factor 1 (15%)	Factor 1 (31%)
Altitud	-0,57	-0,33
NDVI julio	-0,35	-0,06
Pendiente	-0,10	-0,23
Uso abandonado	0,30	0,32
Uso bosque	-0,18	-0,21
Uso cauces	0,33	0,47
Uso humano	0,26	0,00
Uso humedales	0,09	0,54
Uso matorral	-0,18	-0,30
Uso regadío	0,45	0,29
Uso seco	-0,06	-0,03
Marginalidad	0,57	1,47
Especialización	1,08	1,93
Índice de Boyce (DS)	0,72 (0,38)	0,84 (0,35)

Main results

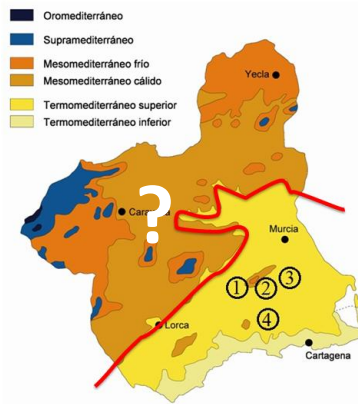


Conclusions (1) and prospects (2)

(1) Although still not generalizable, results can help **decisions** about which **management measures** and their **scale** (e. g. within plot, farm, watershed, subregional) and **intensity** (active reforestation, speed/slow succession)

(2) Next steps forward:

- Assessing new areas (completing surveys) to search for ecogeographical patterns (Murcia Region, SE Spain)
- Rethinking the **rewilding** concept in semiarid agricultural areas (enhancing the role of **ecosystem service suppliers** like dispersers/herbivores)



Acknowledgements

- Financial support to research from:



f SéNeCa (+)

Agencia de Ciencia y Tecnología
Región de Murcia



- Fieldwork and data processing: Biology, Geography and Environmental Sciences students
- Data analysis: J.F. Calvo
- Photographs: C. González Revelles
- Further discussion: [@TimonelAymerich](#)



**Thanks for your
attention**

**Merci pour votre
attention**



Acknowledgements